

Claims

[c1] I claim an apparatus comprising of: a. a chamber for contacting the air with water in presence of electromagnetic energy and catalysts, comprising a water-impermeable enclosure with air intake and air outlet, water intake and water outlet, with at least one water dispersing device or nozzle, which further comprises of, and is part of b. a water circulation loop, comprising of a recirculation pump, at least one water filter, at least one water tank having an inlet and the outlet and a vent with a valve to the atmosphere, one or more means to monitor and control the water level in the tank, a utility water connection, a water heater/cooler, a split valve that splits the water stream in two, with one stream going directly to the water-dispersing nozzles in the chamber, and another stream going through the heat exchanger in the path of the air exiting the chamber, and then to the nozzles in the chamber, thus completing the water circulating loop, c. air purification path comprising an outdoor air intake through the air-to-air heat exchanger connected to the chamber through a vent and a valve, an indoor air intake connected to the chamber through a vent and a valve, or through a three-way valve that controls

the amount and the ratio between the outdoors and in-doors air entering the said chamber, a vent and a valve for the air exiting the chamber towards indoors or towards the air ductwork, d. means to contain the water droplets or mist within the chamber, located in the chamber air outlet, e. one or more electromagnetic radiation sources to irradiate the water in the chamber, f. baffles, webs, channels or other fillers or porous elements that allow mixing and percolation of water and air, g. Solid photocatalytic elements, h. a mixer to enhance the mixing of air and water or to create a vortex or cyclone movement within the chamber, i. an air ionizer in the chamber air intake path to create an electric charge potential between the incoming air and the water in the chamber, j. flame ionization detector in the chamber air intake and the air outlet, k. electrolysis electrodes in the water path towards the water tank, l. means to convey at least part of the hydrogen and oxygen gases generated during the electrolysis to the flame ionization detectors, m. a heater and cooler means to heat or cool the water flowing from the tank into the air-water contacting chamber, which is located either outside the chamber, or in the path of the air exiting the chamber, n. mineral filtering and percolating filling on the bottom of the chamber to capture particulate impurities, o. a polishing filter system comprising of at least one of the car-

bon filter, water-permeable membrane or a fiber bed, or an ion exchanging membrane or a fiber bed, with means to regenerate the said ion exchange bed, p. a water distillation apparatus, attached to the water holding tank, q. a drinking water dispensing outlet, r. sensors located at various points in the apparatus, and a control and threat detection system to automatically control the operation of the apparatus, s. at least one vessel for storing a cleaning or scale removing chemical, for ductwork cleaning, deodorizing and disinfecting chemicals, or a neutralizing chemical against the chemical and biological warfare agents, connected to a air-water contacting chamber, and released into the chamber by opening valves to the water stream for cleaning and de-scaling the interior of the chamber, or to clean the air ducts, or when toxic warfare agents are detected, t. a toxic warfare agent neutralizing chemical, u. a scale removing chemical comprising of an organic or inorganic acid, v. duct disinfecting deodorizing bacteristatic, fungistatic mildewstatic, germistatic, and cleaning chemical, w. electric current rectifier, high voltage and low voltage power supplies.

[c2] [Claim Reference]a. An apparatus as claimed in claim 1, further defined as having an air- water contacting chamber with a fully or partially reflective coating on the

walls, with a door for easy servicing, wherein the chamber outlet is connected to the house ventilation ducts, and the indoor air intake is connected to the return air ducts, means of dispersing or pulverizing the water to create a mist or contacting of water particles within the chamber, comprising of Venturi-effect dispersing head, or an ultrasonic fogging device, or a rotor-stator disperser device, or a device using electrostatic charge to break-up the spray particles, or a perforated "shower" head, dispersing the water into macro, micro or nano-particles, or macro, micro or nano-films on the surface of the solid media, b. wherein the heat exchanger in the path of the air exiting the chamber has a capacity to transfer to the air from about 5 to 95 percent of the heat carried by circulating water, with the said heat exchanger also having a provision for collecting the water condensate into a separate vessel for distilled water, c. outdoor air intake through the air-to-air heat exchanger of counter-flow design, d. means to contain the water droplets or mist within the chamber, of electrostatic precipitator or a loosely woven mesh, e. electromagnetic radiation sources comprising one or more UV-Visible light or electron beam, or electric arc, or X-rays or gamma-rays to irradiate the water in the chamber, f. devices facilitating water and air contact made as macro, micro or nano-particles or macro, micro or nano-fibers, or coat-

ings deposited on the surface of the UV-transparent or reflecting media such as optical glass or other type of hollow or solid fiber, silver, copper wires, or on otherwise shaped support, and shaped in loosely packed webs, coils, woven as cloth, layered, andomly packed, or any other three-dimensional shape, or branching off from the central elongated tube containing the light source, or made as free hanging beads suspended from a string or free floating beads, or randomly or orderly packed, g. devices that facilitate contact of water with air, made of photo-catalytic or fluorescent media, comprising of titania, or vanadium or molybdenum or otherwise doped titania, magnesia, zinc oxide, alumina, apatite, limestone, MnO₂, aluminosilicate, clay, k. electrolysis electrodes made of graphite, or silver or copper, or coated with silver or copper, shaped as horisontal mesh plates, or as a cylinder around a vertical rod or as several concentric cylinders with alternating polarity, n. a water filtering system comprising of at least one water filter for filtering out particulate, a back-flushing system for the particulate filter, and at least one water filter for filtering out other impurities, wherein the water filter for filtering out particulate is comprising of from 0 to 100% coarse sand, from 0 to 100% or gravel, and from 0 to 100% crushed limestone, calcium carbonate, or calcite, o. a water filter for filtering out other impurities comprising

of at least one of the carbon filter, or a water-permeable reverse osmosis membrane or a fiber bed, or an ion ex-changing membrane or a fiber bed, p. a water distillation apparatus, attached to the water holding tank, q. a drinking water dispensing outlet, which is drawing water from the circulating system, or from the distillate re-ceiver, with means to additionally filter the water during dispensing, such as reverse osmosis unit, and means for heating or cooling the drinking water, r. a control and a threat detection system to automatically control the op-eration of the apparatus to purify the air and provide de-sired indoor temperature and humidity based on the in-dication of the sensors, comprising sensors, data pro-cessors, actuators, comprising of means to switch the water circulation loop from normal to emergency mode when threat is detected, to isolate the storage tank from the source of the threat, to introduce the neutralizing agents in the water, and circulating such water through a separate neutralization loop, and means to transmit the threat alarm to a remote location, means to control the temperature of the circulating water, thermostat to con-trol the temperature of the indoor air by heating or cool-ing the water before it enters the chamber, means to control the indoor-outdoor air exchange rate, and the ratio between the incoming air stream from outdoors and the recirculation indoors air that goes through the

water contacting chamber, means to control the water circulation rate, means to control the ratio of water entering the water dispersing devices 270 directly, or through the heat exchanger coils, sensors, comprising flame ionization detector, pH and conductivity sensors, IR and fluorescence sensors, air quality sensors, such as temperature and humidity sensors, carbon dioxide, carbon monoxide, ozone, air particulate sensors, water quality sensors, such as temperature, pH, turbidity, oxidation or reduction potential, conductivity, chemical and biological toxins sensors, using UV fluorescence, IR spectroscopy or other as ways to identify the threats, t. a toxic warfare neutralizing agent comprising alkali or alkaline earth metals oxide, hydroxide, peroxide, percarbonate, persulfate, permanganate, or ammonium or N-substituted primary, secondary, tertiary or quaternary amines or amine oxide, hydroxide, peroxide, percarbonate, persulfate, permanganate, or organic peroxides or their mixtures, and mixtures with additional surfactants, catalysts, enzymes, stabilizers, dispersants and other aids, u. a scale removing chemical comprising of an organic or inorganic acid.

[c3] [Claim Reference]a. An apparatus as claimed in claim 1, further defined as having the contents of the chamber assembled from the individual rectangular stationary

trays, or round rotating modular trays, wherein the heat exchanger in the path of the air exiting the chamber has a capacity to transfer to the air from about 25 to 75 percent of the heat carried by circulating water, a back-flushing system for the particulate filter, comprising of a floating lever that activates the back-flushing cycle when the water raises above the pre-set level, a mechanism that closes the valve from the chamber to the water tank, and opens the utility water connection to the bottom of the chamber and the drain valve, a vibrator, to vibrate the particulate filter during the back-flushing, a heater to heat the water during back-flushing, a valve to remove the flush water, the water filter containing activated carbon, and an ion exchanging membrane or a fiber bed, with means to regenerate the said ion exchange bed electrolysis electrodes 255, made of silver, copper or other metal that produce antiseptic ions when dissolved, sensors: flame ionization detector, UV fluorescence, IR spectroscopy or other as ways to identify the threats, and in particular these using photo-catalytic media, comprising of titania, doped titania, magnesia, zinc oxide, alumina, apatite, MnO₂ micro or nanoparticles or nano-fibers, or coatings deposited on the surface of UV-transparent optical silica or glass fiber, or metal fiber, a toxic agents neutralizing chemical comprising alkali or alkaline earth metals oxide, hydroxide,

peroxide, percarbonate, persulfate, permanganate, hypochlorite, or ammonium percarbonate, persulfate, permanganate, trisodium phosphate, hydrogen peroxide, and mixtures with additional surfactants, catalysts, enzymes, stabilizers dispersants and other aids, a scale removing chemical comprising of glycolic, acetic, phosphoric, hydrochloric acid, a duct disinfecting chemical comprising ethyl alcohol, and quat disinfectant.

- [c4] [Claim Reference]a. An apparatus as claimed in claim 1, further defined as having the solid contact media contents of the chamber assembled from the individual round horizontal modular trays and means to spin them around the vertical axis to facilitate mixing air and water, and the material in the tray is shaped for propelling air upwards, and furthermore, the trays are rotating by the power of the water running through the chamber, or the water dispersing device is rotating, or both,
- [c5] A distillation apparatus, suitable for water or other liquids, either free standing, or attached to a liquid holding vessel or tank, which apparatus or the apparatus and the tank are used either as a separate and independent stand-alone device, or as a part of another apparatus like the distillation apparatus 800 and the tank 300 in claim 1, comprising of a vertical or inclined pipe 810, which said pipe 810 is open at the top and closed at the

bottom with a removable plug 811, which said pipe is connected near the bottom to the liquid supplying source, or to the tank, establishing two communicating vessels with the tank, wherein the liquid level controlling means are established in the pipe 810 or in the tank 300, which said pipe 810 is either of the same diameter throughout, or is widened 820 at the top, and which said pipe 810 has the outer surface of a simple regular pipe, or is shaped or lined with heat conducting rings 840-1, or spirals 840-2, or has curved, spiked, broken, spiral or other shape or combination of shapes for facilitating the heat transfer between the inside and the outside of the pipe, and which removable plug 811 can have a wire 831 going through to the heating element 830, heating means 830 to boil the liquid at the top part 820 of the pipe 810, with the vapors escaping over the top of the pipe and down, where they are condensed on the way down on the outside surface of the pipe 810, establishing a counter-flow heat exchange between the downwardly moving liquid vapors on the outside of the pipe 810, and the upwardly moving cold liquid inside the pipe from the liquid source or from the tank, the outer cover 850 enclosing the pipe 810, with an air gap between the cover and the top and the walls of the pipe 810, with said cover having an upper end, and a lower end, with the upper end closed to the atmosphere, which can have

a sealed hole for the wire that leads to the heating element 830 from above or from the side or from the bottom, and said cover is open to the atmosphere at the lower end, and lets the condensed distilled liquid fall into the distillate receiver vessel 900, which said cover has a slot at the lower part to accommodate the pipe 805 when the cover is lowered in position.

- [c6] [Claim Reference] An apparatus as disclosed in claim 5, wherein the heating means comprise either infra-red, solar, microwave, or other radiation heat source, or an electric resistance heating element, or thermoelectric Peltier Effect element, with wires 831 supplying electrical energy either through the top, or through the bottom, or through the sides of the cover 850.
- [c7] A method comprising of (a) exchanging the outdoors and indoors air while efficiently exchanging the heat, with the outdoors air moving indoors and indoors air outdoors through the counter-flow heat exchanger, (b) filtering the incoming outdoors air by passing it through the water contacting chamber, which traps the particulate pollutants in water droplets, and at the same time purifies the indoors air by (c) recirculating it through the same chamber, (d) disinfecting and oxidizing the pollutants by irradiating with the UV light the water and air mixture in the contacting chamber and (e) disinfecting

and oxidizing the pollutants by electrolyzing the water in the contacting chamber and (f) by percolating the air-water mixture through the limestone bed in the chamber, (g) heating or cooling the indoor air through controlling the temperature of the circulating water in the chamber, (h) humidifying or dehumidifying the indoor air through controlling the temperature of the circulating water in the chamber, and through controlling the ratio of the water flowing directly to the chamber to the water flowing to the chamber through the heat exchanger placed on the exit path of the air flowing from the chamber, (i) condensing the water from the air by cooling the water, and (j) converting it into clean potable water through circulating it through the water filter system along with the rest of the water, between the water holding tank and the water contacting chamber, thus continuously purifying the water, (k) storing the water in the water holding tank, and (l) removing particulate through the sand and limestone filter, and toxic impurities, and the oxidized by-products of pollutants by filtering through the ion exchange media, and by distilling the water through a distillation apparatus 800, (m) recycling the filter by back-flushing, (n) cleaning and disinfecting the air ducts by periodically introducing hot water mist of small particle size, ethyl alcohol and quat disinfectant, or hot water mist and ozone, or both in sequence into

the air ducts, and (o) isolating the water tank and closing the outdoor air supply when threat is detected, and running the neutralizing solution through the air-water contacting chamber.

- [c8] Ceramic porous media made by pyrolyzing mixtures of the sugars or polysaccharide derived polymers with pre-ceramic materials with pre-ceramic materials, wherein the sugars or polysaccharide based pre-cursors are first reacted or blended with pre-ceramic reagents, then the resulting graft copolymer or blend is sintered.
- [c9] [Claim Reference] Materials of claim 8 wherein the polysaccharide derived materials are sugar, glucose, glycerol, cellulose, carboxymethylcellulose, amino-functional cellulose, cellulose phosphate, cellulose borate, chitin, chitosan, and the pre-ceramic materials are alkoxy silanes, halosilanes, haloalkoxy silanes, such as tetraethoxysilane, tetrachlorosilane, polysiloxane, alkali or alkali earth metal silicate, alkali or alkali earth metal aluminate, alkali or alkali earth metal titanate, alkali or alkali earth metal borate and perborate, alkali metal or alkali earth phosphate, alkoxyaluminates, alkoxytitanates, aluminum halides, titanium halides, aluminum alkoxyhalides, titanium alkoxyhalides, or blends of such materials and blends with other materials.